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ABSTRACT

This unit begins with the historical development of Florida and analyzes development from the perspective of an energy system. The unit deals with the urbanization process currently taking place in Florida and explores where it may be leading. Lessons are designed for individualized instruction or for use by students in small groups. In some cases material may be used by students in large groups. (Author/RE)

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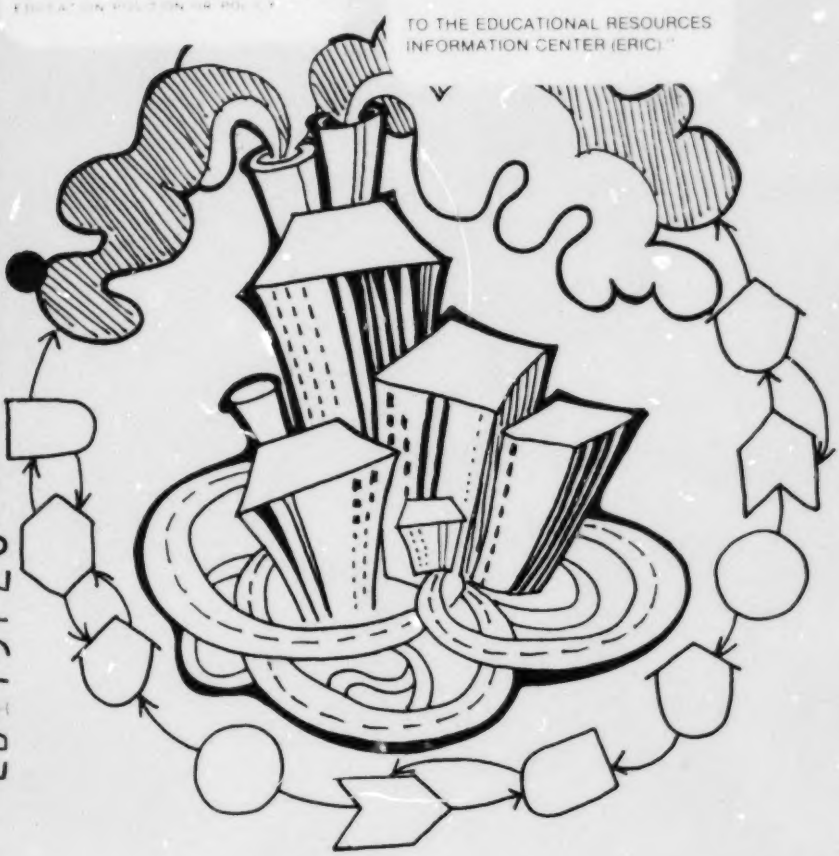

Florida's Urban Environment

ED 087270

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"... I think what's going to have to be done in the next three or four years is for everyone, but especially for the students who are just entering the world, to re-evaluate the whole position in this country that we're facing in regard to what we do for money and what money will buy and what money won't buy."

"... What we're going to have to do is to change the patterns of consumption in this country and in the rest of the world. The same thing is true of energy... we're going to have to think in terms of energy units instead of in terms of money..."

"... So we have to learn something new, and it's going to be rough."

Margaret Mead
Boston, 1975

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All photographs are scenes taken in Florida's cities, farms and wilderness.

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I. INTRODUCTION

Each of us is a part of the environment. We affect the environment and it affects us. A safe, healthy environment is essential for our existence. Yet, we have caused serious changes about us. We have brought about an environment that soon may no longer meet our requirements for survival. We must examine ourselves in order to understand what has caused these environmental changes.

Early man's effects upon his environment were minimal. His role was one of participating in environmental changes as they happened, rather than causing them to take place. He found food, water, and shelter more by chance than by design. He was extremely dependent upon nature, barely managing to eke out an existence from his surroundings. Primitive man still has this role, but modern man has progressed far beyond a humble dependence upon what his environment happens to be or what happens to take place within it.

Modern man is able to cause profound changes in his environment. In this he is unique. All other species have been limited to the effects they could cause by the force of their own bodies. But modern man, through the use of his intellect and technology, has multiplied the effect of his body many times over. Using these effects, he has changed the environment-- the land, the air, the water, and the living things of earth. Some of these changes have been beneficial, many have been harmful.

Now man the changer must find ways to maintain an environment suitable for himself and all other living things. Only recently has man realized his responsibility for maintaining a healthful environment. The serious environmental problems we are facing today demonstrate the impact modern man has had upon the environment.

We have the intelligence and ability to meet the crisis of the environment. To solve this crisis, we will need to re-educate ourselves about our responsibilities to nature. We hope that this program will aid in that re-education.

II. OVERVIEW

This program is designed to help students to understand their environment. In this program, students are encouraged to explore their environment from an energy systems approach. Earth's processesses and systems are examined in terms of energy flows. The students consider the complex workings of "spaceship earth" and become aware of the effects modern man is having on it.

Students, however, differ in their ability to learn. They differ from region to region, from age level to age level, and from class to class. Moreover, no one student learns equally well in all modes of instruction. The components of this program have been designed to overcome such disparities of learning.

In this program, students use a variety of instructional modes and media. By hearing, seeing, feeling, and doing the students become involved in a variety of learning experiences.

The various components of this program are readily adapted to the different modes of instruction commonly used today by students in their learning activities. Using these components for individualizing instruction, a student can work alone and progress at his own rate. These materials may also be used by students in small groups of three or four as they stimulate one another's thinking, exchange thoughts, and discover ideas. In some cases, the students may choose to work with the materials in large groups. The program is designed to allow

and to encourage such flexibility in its use.

MAJOR OBJECTIVES

There are three major objectives to be achieved through student involvement in this program.

1--- The students will discover basic information and understand basic concepts about environmental systems and will demonstrate their comprehension by appropriately applying the concepts in activities.

2--- The students will be able to identify major environmental problems, will be concerned about these problems, and will be able to discuss some ways these problems can be resolved.

3--- The students will demonstrate a personal commitment by taking actions which will aid in the prevention or solution of environmental problems they observe.

PROGRAM STRUCTURE

The materials included in this program are open-ended in the development of content and concepts. In their use of these materials, the students are offered a wide range of options for further development of information and ideas and for the application of what they find.

The program "Your Florida Environment" consists of three modules:

Module #1 --- "How Things Work"
An exploration of Earth processes and systems from an energy point of view. Energese, the energy system language used throughout the program, is explained.

Module #2 ---- "Florida's Urban Environment"
Beginning with the historical development of Florida from an energy systems approach, this program deals with the urbanization process in Florida and explores where it is leading.

Module #3--- "Endangered Species"
An examination of the causes of the endangerment of Florida's plant and animals species with a detailed look at Florida's varied ecological systems. A view of the complexity of the balance of nature and this relationship to man.

Each module contains one sound-filmstrip and a Teachers Guide. The sound-filmstrip is designed to operate either manually or automatically by cassette tape player and filmstrip projector.

The subject matter developed in these materials is appropriate for students from cities, suburbs, or rural areas. These materials are directed at students from grades 5 and above.

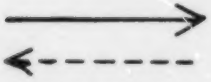
ENERGETICS LANGUAGE

The "Your Florida Environment" programs use a pictoral language that symbolized systems relationships. This language, Energese, ** is used to describe the complex processes and systems involved in understanding the environment. The symbols used in this language are:

ENERGY SOURCE symbol represents a source of energy from outside the system such as the sun, fossil fuel, the water from a reservoir, or iron ore from the ground.

ENERGY STORAGE symbol (tank shape) shows the location in a system for storage. Examples are a grocery store, into which potatoes are moved and later removed, or a fuel storage tank. Some work must be done by some other unit in order to move the energy in and out of the storage.

INTERACTION symbol shows the coming together of two or more energy sources needed within a process in order to produce the result. An example is the interaction of the farmer's labor, sunshine, fertilizer, soil, etc., to produce a crop.

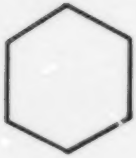


a) THE PATHWAY symbol is used to indicate the flow of energy from one part of the system to another part.
b) THE DASHED PATHWAY symbol is reserved to show the flow of money.

THE PRICE symbol shows that within man's system there is usually a flow of money to pay for the energy. An example is the exchange of money in a grocery store for the food that we buy.

THE HEAT-SINK symbol. Heat, the random thermal motion of molecules is the ultimate fate of all energy. As energy flows through any system it becomes degraded, i.e., it loses the ability to do further work. Three different examples of the way in which energy degrades are: (1) the loss of energy due to friction (2) the natural depreciation that occurs when any energy is stored (3) the consumption of energy in order to run or process any type of energy interaction.

THE PRODUCTION symbol represents a self-maintaining production population, such as trees and grass. It also contains storages and interactions and has input energy such as sunshine combining with raw materials to produce a useful output such as trees. While production unit is normally associated with plant operations, it can also be used with any production process that contains a cycling, self-limiting material flow.



THE CONSUMER symbol represents a self-maintaining consumer population, such as deer or the residential sectors of our own society. Within it are combinations of storages and interaction units.

** Energy Crisis to Steady State, H.T. Odum

MODULE # 2 "FLORIDA'S URBAN ENVIRONMENT"

The teacher is a very important factor in the success of any program. This part of the guide contains ideas for the use of this module that can help you obtain maximum student participation with a high level of achievement. These ideas, guidelines, observations, activities, and practical suggestions are offered for your use. Any approach or teaching pattern offered is not intended to show you the way to use the program. As the teacher, you will develop many ideas and approaches to suit your style of teaching to fit the learning patterns of your students. Use whatever works best for you and your students.

MODULE #2 "FLORIDA'S URBAN ENVIRONMENT"

OBJECTIVES :

Students will be able to discuss urbanization trends in Florida and describe them in energetics language. Students will be aware of the energy needs of cities and will be able to make life-style decisions accordingly.

CONCEPTS DEVELOPED :

It took the availability of work from concentrated forms of energy before Florida could be developed.

Tourism was the major force for development in Florida.

Our cities are dependent on energies of nature as well as fossil fuel.

The growth of cities corresponds to increasing effects on the natural environments.

Many cities ignore the free work done by the natural environment and replace this work with that done by fossil fuels.

Our cities will diminish with diminishing availability of concentrated energy.

(1) Florida's Urban Environment

(2) Produced by the Florida Audubon Society.

(3) Florida...Environmentally unique to the North American Continent...Jutting out into the Atlantic Ocean and Gulf of Mexico

(4) Florida...possesor of a subtropical climate supporting an abundance of plant and animal life.

(5) Florida...producer of a bounty of foods for the nation

(6) Florida...vacation paradise

(7) Today Florida is our fastest growing state with 6,000 new residents per week coming to live in and enjoy our climate, natural resources and beautiful recreation spots...

(8) But Florida was not always such an attractive place in which to live.

(9) Just 75 years ago, when many northern cities were bustling metropolises, and much of their surrounding lands had been cleared for farming to provide for the needs of their people, Florida's population was only about 500,000.

(10) Life was not easy for the early Florida settlers. In the late 1890's the thick jungle-like forests were cleared by hand or animal power to make way for towns and farms.

(11) Yellow fever wiped out entire communities. Floods, frosts, and hurricanes destroyed the efforts of the hard working people. Many returned home to northern states broken financially and discouraged.

(12) Florida's environment presented these people with an enigma. How could this land of warmth and beauty posses so much scorching heat and pestilence ?

(13) Despite these hardships, the writings of popular novelists of the day so eloquently described the beauty and wildlife of Florida that people from all over the world wanted to visit and see it for themselves.

(14) At last this was made possible by the advent of the railroad and steamship lines.

(15) Goods and people were more easily carried into Florida at the turn of the century making it the number one tourist attraction in the nation.

(16) Many tourists stayed to try to make their fortunes in this rugged land.

(17) Steam powered engines made possible the development of the wilds of Florida into havens for tourists...

(18) and coastal trade centers to all points of the globe.

(19) Hotels and restaurants began to spring up at stopping off places along the transportation lines.

(20) Nature's might had been overcome by a greater power...the steam engine.

(21) Historically the best lands in Florida were those that were high and dry, and these were the first to be developed by the wealthy transportation companies...

(22) and equally wealthy tourists who decided to stay here.

(23) As the tourists and the railroads ventured further south into Florida, cities were built to serve them.

(24) Much of the land ajoining the cities were converted from forests and glades to agricultural land.

(25) So money, machines and good old sunshine were the muscle that built such cities as Tallahassee, Jacksonville, Daytona, Orlando, Tampa, Palm Beach, Miami and Key West.

(26) More tourists and speculators came to Florida bringing money, machinery and labor forces.

(27) With more people in the cities more land had to be cleared for growing food.

(28) Since the dry lands were already in use, the wetlands had to be drained for agriculture. The machinery to do the job was brought into Florida.

(29) The success of the draining operations made it possible to grow an abundance of food. The excess was sold to the northern cities.

(30) With the additional income to buy more machines additional lands could be drained and farmed. The cities grew.

(31) The establishment and growth of cities depend on the energy available to the people who live there.

(32) Energy is the ability to do work.

(33) Most cities start as small nodes where transportation systems cross on lands that are easily managed to support the needs of the people living there.

(34) Think of a small city developing at the intersection of two transportation lines. If the transportation system grows and carries goods and people to the small city, then the city will grow.

(35) People using the transportation system spend money in the city. Then with the money it gets from the transportation system the city can provide more goods and services such as stores, hotels and restaurants to the system. These services bring more people to the city, and the city grows.

(36) Another way of looking at the development of cities is in terms of energy systems. Think of the city we have just described.

(37) It looks like this in energetics language. Energetics is a language used to desctibe complex happenings in a systematic manner.

Here the circles represent the energies flowing into the city, and the lines and arrows show the direction of this flow. The free, natural energy is sunlight, wind, rain, waves, and tides. The purchased energy is fuel, machinery and labor forces. Both of these forms of energy do work for the city.

In order to attract tourist money our city establishes hotels, restraurants and attractions. With this money our city can buy more things that will help it make more money. In essence it is feeding back some of its energy to interact with other energies in order to bring in still more energy. This process is shown by flow A and the energy interaction by pump B.

The money transaction which has taken place is shown by the diamond. Here the transaction is the city's exporting goods and services in exchange for dollars. The money flows in the opposite direction to energy flow.

The water tank symbol represents the city's structure. Structure is buildings, roads, businesses, machinery, people, government, goods, services, and information. Structure can also be defined as a storage tank of energy waiting to be used.

We can now state two principles by which cities develop:

(38) A city needs energy to grow.

(39) A city must use some of its energy to get more energy.

(40) Look at the pattern of urban development in Florida. The white sections are the urban areas.

The white sections also represent developed farm areas which are relatively less inhabited by people.

As you can see over half of Florida has been developed. About 80% of all the people of Florida reside in cities.

(41) The functioning of cities is a complex, simultaneous interaction of people, economics, government and culture. To study and understand each of these parts of the city would be a monumental task.

(42) But with the language of energetics and the concept of systems we can step back and look at the city as a whole...as a living, breathing existence in our environment. Let's look at how cities function.

(43) Cities are supported by agriculture. Farmers grow food and send it to the city. In exchange the city gives the farmer money. In energetics the city and farm look like this.

(44) The source of energy is the sun. The bullet shaped symbol represents the producers of the system. Here the farmer is producing food for the system. The hexagon is the city and hexagons always represent consumers. The storage tanks are the farmer's or the consumer's reserve of money. The diamond and dashed line show that a transaction has taken place, the selling of food to the city.

(45) But the farmer needs tractors, fertilizer, and other goods that the city produces. So the farmer must pay the city. Food going from the farm to the city is a form of energy for the city, and tractors, fertilizer and goods are the energy flowing from the city to the farm. Now we have a loop, where money flows in the opposite direction to the energy flow.

In this system the farmer helps the city by selling his food there, and the city helps the farmer by selling him machines, goods, fertilizer, and tractors.

(46) This is how some Florida cities work. In Florida more of certain kinds of food is grown than the inhabitants care to eat. So we export our excess food. We don't grow all the food we like to eat so we import these from other states.

With the money we make from selling exports we buy things we need. Toursits spend lots of money when they come to visit. With this the city can buy even more goods as well. Energetically our city looks like this. In this system tourists and purchased goods have become sources of energy because they are causing the system to grow.

(47) If we look at the parts of a city we notice that it is a collection of buildings, transportation lines, natural resources, machines, and people. Cities are supposed to be for people. All the parts of the city have one thing in common....

(48) They all run on energy.

(49) In general there are two kinds of energy in nature. There are the...

(50) very concentrated energies called fossil fuels.

(51) These take the form of coal, gas, oil.

(52) Then there are the dilute energies called sunlight, rain,

(53) wind, waves and tides.

(54) Each form of energy is capable of doing only certain kinds of work.

(55) For example: Plants can use only the energy from sunlight to live and grow.

(56) Likewise, cars run better on gasoline than sunlight.

(57) Our cities need both forms of energy. We need the fossil fuel to run tractors and make fertilizer which add to the energy available to our agricultural systems. This enables us to grow more food.

(58) The winds are a form of solar energy which we need to cleanse the air and blow cooling breezes through our cities.

(59) We need the rains for our crops and to provide us with water to drink.

(60) We depend on the tides and waves to stir the oceans so that the sea may provide us with fish to eat.
Every day in many ways we use the free energies of nature.

(61) Energetically we can show the energies flowing into the city. Notice that there are two pumps here.

(62) If one of the pumps stops functioning, the other will have to pump harder to maintain the system. Otherwise the system will slow down.

(63) In our cities if the dilute energies of nature are not used, then the job that they do for us will have to be taken over by fossil fuels. Otherwise the system will run down or get smaller.

(64) We depend on whole ecosystems of plants and animals to do work for us. They build and maintain soils, purify water, add moisture to the air, cool the air, prevent erosion and on and on.

(65) If we remove too many of nature's ecosystems while we develop our cities, then we will have to spend some of our costly fossil fuels to do the work that nature did for free.

(66) For example: If we dredge and fill the mangrove systems of the coastline, to build houses, then we must also use our energies to prevent the coastline from eroding. We would have to use precious fossil fuel to keep the waves and tides from washing away our houses.

(67) Many of the central areas of our cities do not contain enough vegetation to cool the air. These areas are always warmer and require air conditioners to cool the houses. Here we have to use electricity generated by the burning of fossil fuels to run our air conditioners.

(68) Residential areas that have lots of trees and vegetation are cooler and therefore don't need to use as much electricity to run their air conditioners.

(69) We see that dilute natural energies are a necessary part of the total energy that cites use. Without these dilute energies t costs of operating and maintaining our cities would be much greater than they need to be.

(70) Cities depend heavily upon fossil fuels for their operation and maintenance, and these fuels are getting scarce and more expensive. It is therefore good common sense not to waste what little fossil fuels we have on doing work that nature will do for free.

What do you suppose would happen if we took away some of our natural systems that we depend upon to do work for us ? This is what has happened in Florida...

(71) As our cities developed more structure the free energies of nature became less available or were simply ignored. The winds were not used to cool houses and buildings . Instead they were air conditioned.

(72) Trees and shrubs that also cool the air were often removed from a building site.

(73) When our cities were small and less populated, the energies to run them were small. The effects that the city has on its surrounding countryside was also small.

(74) But as the cities grew and as the fossil fuel energies available to the cities grew as well the effects on the surrounding environment have been collosal. We now know that the concentrated energy has a by-product, and it is concentrated waste. We call it pollution.

(75) A large city causes more pollution than a small city.

(76) There are more car engine exhausts to foul the air,
(77) more solid waste to dispose of,
(78) more sewage flowing into the surrounding countryside, more industry. In Florida we have polluted estuaries, lakes, rivers, swamps, the air and the soil.

(79) These natural systems can no longer do the work for us that they did before they were polluted. Fishermen notice a great reduction in their catches.

(80) The hot winds blow foul smelling gasses into our homes.
(81) The marshes and swamps become overloaded and cannot assimilate all our wastes.

(82) Our beaches are eroding, and the sea is claiming what we have foolishly built upon the dunes.

(83) As cities developed and grew surrounding ecosystems were altered to provide food for the cities.

(84) As surrounding ecosystems were altered or ignored the free work done by them was replaced with work done by fossil fuels.

(85) As the city uses an increasing amount of concentrated energy to maintain and enlarge its structure an increasing amount of concentrated waste is generated and flows into the surrounding ecosystems.

(86) It takes energy just to protect the structure of a city. The more complex our city becomes the more laws,
(87) policemen, firemen, government officials,
(88) utilities, and public agencies are needed to protect and maintain it. All of these services cost energy to run.

(89) Likewise, the smaller the city the less energy it takes to protect and maintain its structure.

(90) Compare the small town's police station
(91) with this one in service to a large Florida city.

(92) It takes more energy per capita to run a large city than it does to run a small one. We can say that larger cities are more energy intensive than smaller ones in providing their people with a comfortable, safe, and pleasant place in which to live.

(93) As long as the energies that we need to run our cities are abundant, then our cities will continue to function in an energy intnesive manner. There is hard evidence however, saying that the energy we use to run our cities is becoming harder to obtain and that these supplies are no longer abundant. They are in fact limited.

(94) What will our cities be like then if our concentrated energy sources decrease ?
We have shown that the city depends on both the dilute and conentrated forms of nature's energy to maintain its structure and to grow. Therefore, when the fossil fuel energy becomes scarce, the city will decrease in size until it reaches a point where it can be sustained by the available energy sources. It would not completely crumble because it would still have the free dilute energies of nature on which to depend.

(95) The city that has maintained and preserved more of its surrounding ecosystems will have more free energies on which to live than the city that has polluted, destroyed, and altered its lands.

(96) With the decreasing availbility of the fossil fuel energy sources we may notice a gradual population exodus from the cities.

(97) Those residents that can leave will do so, for the city will not be able to provide them with a comfortable, safe, and pleasant place in which to live.

Where will these people go ? Some will go to less populated cities.

(98) Others will go to rural areas that are agriculturally oriented. There they will be able to obtain maximum benefit from the free energies of nature.

(99) Small agricultural communities with small manufacturing areas to make products for local consumption will develop. No longer will society be able to transport goods over great distances. Regions such as Florida will grow and produce most of their own food and products.

(100) These communities would have a diverse mixture of housing; agriculture; small shops, industry, and schools.

(101) On the other hand, what would happen if we discovered an unlimited source of concentraded energy?

(102) Earlier we showed that cities increase in size and structure as the energy available to them increases. So with added energy from unlimited sources we can expect the cities of Florida to grow even larger...

(103) with greater populations and increasing complexity, mainteninence problems, and effects on our surrounding ecostems.

(104) What will life be like ?
Will the city of unlimited energy provide a more comfortable, safe, and pleasant way of life ? Or will we find that the quality of our lives has been degraded because of increased crowding, the destruction of natural ecosystems surrounding the city, the conversion of all the good agricultural lands into pavements and buildings ? Will all the ecosystems have been altered such that most natural plants and animals will vanish ?

(105) Can we make laws to somehow minimize our effects upon the land? Can we preserve the dwindling areas of natural ecosystems ?

(106) Will the availability of an unlimited energy supply be a blessing to mankind or will it be a curse?

(107) A third option is left to us as city builders. We can build our cities in accordance to and with respect for the natural laws that govern this planet. We can build cities and towns that enhance and help maintain these laws rather than disrupt them. We can preserve the valuable and essential energies that are provided for us.

(108) Clean air to breathe, clean water to drink, good soil protected from erosion on which to grow food... These needs can be provided by the city builders.

(109)

(109) WHAT KIND OF CITY DO YOU WANT FOR YOUR FUTURE ?

(110)
(111)
(112)
(113)

(114) This program was made possible through a grant from the Division of Technology and Environmental Education, Office of Education, United States Department of Health, Education and Welfare.

MODULE # 2 "FLORIDA'S URBAN ENVIRONMENT"

ACTIVITIES:

Investigate your city, neighborhood, school campus. Find examples of nature doing work in these areas. Find examples of people replacing work done by nature with work done by fossil fuels.

How can you personally rely more on nature's work and less on fossil fuels ?

Is there pollution in your city ? What can be done to lessen it ?

Are there areas in your city that have retained much of their natural vegetation ? How are these areas different from other areas which have no natural vegetation ? Which areas do you like to live in, those with natural vegetation or those without ?

Working in groups make models of cities of the future : Those that respond to limited concentrated energy, and those that respond to unlimited concentrated energy. Put them on display for view by the entire school.

Rate yourself and your classmates on this scale:

fossil fuel guzzler / / / / / / / / / / / free energy consumer

Just for fun, compare.

MODULE # 2 "FLORIDA'S URBAN ENVIRONMENT"

SUPPLEMENTAL AIDS:

Selection of material for this section does not constitute official endorsement or approval of it by the Florida Audubon Society, or the United States Office of Education to the exclusion of others which may be suitable.

Environment, Power, and Society, Howard T. Odum. Wiley-Interscience, a division of John Wiley and Sons, Inc., New York

This book offers a macroscopic view of man and his part in the delicate balance of forces that sustains life in the biosphere. To analyze man made and natural forces, the author discusses the common denominator that unifies these seemingly disparate energetic processes -- power.

Natural energy such as solar radiation, the hydrolic cycling of the oceans, or the cyclic exchange of carbon, hydrogen, oxygen and nitrogen can be easily diagramed in terms of power. But the author shows that the affairs of man also have quantitative power ratings and that the important issues of man's existence and survival are as fully regulated by the laws of energetics as those of the physical and chemical world.

Energy Crisis to Steady State, Howard T. Odum, McGraw-Hill

This book is designed as a text for high school and junior college students to introduce them to energy systems language. It deals with the concept of systems, explains the energy principles, relationships of energy and growth, energy and money. The book shows how these principles are applied to all systems from individual organisms to nations and the world.

The book ends with an analysis of what the future holds for man as we begin a new era of limited energy and thus a steady state, no growth way of life.

Yesterday's Miami, Nixon Smiley, E.A. Seemann Publishing, Inc., Miami, Fl $7.95

A collection of pictures and text on the history of Miami from its inception to the early 1950's. The faces, fantasies, and facts of the personalities that made Miami what it is today are displayed.

MODULE #2 "FLORIDA'S URBAN ENVIRONMENT"

Yesterday's St.Petersburg , Hampton Dunn, E.A. Seemann Publ.Inc., Miami $7.95

A collection of pictures and texts on the history of St. Petersburg from the late 1880's to the early 1970's.

Also in the series:

Yesterday's Key West, by Stan Windhorn and Wright Langley

Yesterday's Sarasota, by Del Marth

Yesterday's Tampa , by Hampton Dunn

Yesterday's Clearwater, by Hampton Dunn

Yesterday's Florida , a collected selection of all the above.

"The Land Use Planning and Growth-Control Dilemma" , ENFO Newsletter, The Environmental Information Center of the Florida Conservation Foundation, Inc., 935 Orange Av., Winter Park, Fl 32789.

Explores the American concept of land as a commodity and growth-control conflict.

"A Systems Analysis Approach to Planning for a Changing World", ENFO Newsletter

Introduces modern decision makers to the energy systems approach to socioeconomic problem solving. This technique can be used by individuals, industry and government for aid in understanding and evaluating the profound changes occuring in the structure of society and affecting our daily lives.

"Energy, Ecology, and Economics" Howard T. Odum, ENFO Newsletter.

In this Dr. Odum reported to the Royal Swedish Academy of Sciences his theories of net energy and steady state economy.